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MISSISSIPPI RIVER: STUDY OF ALTERNATIVES FOR
REHABILITATION OF LOCK AND D. (U) CORPS OF ENGINEERS ST
PAUL MN ST PAUL DISTRICT APR 76

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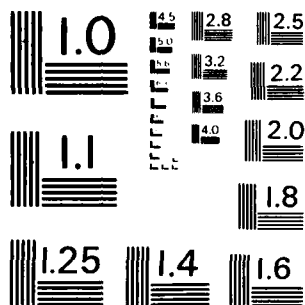
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**STUDY OF ALTERNATIVES FOR REHABILITATION
OF LOCK AND DAM NO. 1**

MINNEAPOLIS, MINNESOTA

**SUPPORTING DATA
FOR
APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION**

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ST. PAUL DISTRICT, CORPS OF ENGINEERS
ST. PAUL, MINNESOTA**

APRIL 1976

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) It is recommended that both the landward lock, the riverward lock and the dam at Lock & Dam no. 1, Minneapolis, Minnesota be completely rehabilitated. Based on studies completed to the date of this report, more detailed studies are required to firmly establish cost estimates, environmental effects, and the construction scheduling necessary to insure the work can be completed in the proposed two year construction period without delaying navigation.		

DEPARTMENT OF THE ARMY
St. Paul District, Corps of Engineers
1210 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

MISSISSIPPI RIVER
STUDY OF ALTERNATIVES FOR REHABILITATION OF LOCK AND DAM NO. 1
MINNEAPOLIS, MINNESOTA

SUPPORTING DATA
FOR
APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION

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HARZA
ENGINEERING
COMPANY
CHICAGO

SUBJECT SUPPORTING DATA - APPENDIX A
ALTERNATIVE PLANS OF REHABILITATION
COMPUTED _____ CHECKED _____

PROJECT LOCK & DAM No. 1
FILE NO. 800 A
DATE 4/24/75 PAGE 1 OF 1 PAGES

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AND MANPOWER:

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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No 1</u>
	<u>Excavation and Embankments</u>	FILE NO <u>80017</u>
	COMPUTED <u>GJK</u> CHECKED _____	DATE <u>1/2/75</u> PAGE <u>1</u> OF <u>65</u> PAGE

Figure costs for the various types of excavation for Lock & Dam No. 1. As before use current labor rates for Minneapolis & current equipment costs from CECRB. Use 35% for profit & overhead. Add 15% for escalation. Note: Relatively insignificant items will not be covered in these notes.

Dredging:

Use backhoe on the bank, figure low production rate for under water work. Say 1 cu. yd. machine at 30 cy/hr.

1 Operator	8.90	8.90	
1 Diler	8.00	8.00	
3 Truck Dr.	7.20	21.60	
2 Flagman	7.70	15.40	
		<u>53.90</u>	
	N/OT at 8.3%	58.40	58.40
1 Backhoe		24.00	
3 10 cy Trk. on highway	19.00	57.00	
		<u>81.00</u>	81.00
			<u>139.40</u>

Per cu. yd. 4.65
 N/profit & overhead 35% 6.27
 N/ Esc. 15% 7.21
 Small quantity use \$9.00

Backhoe excavation for structures

Say product would be 50 cy/hr Add disposal separately

diler & Operator N/OT	18.30	
Backhoe	24.00	
2 Flagmen N/OT	16.70	
Direct	<u>59.00</u>	
per cy (1.50)	1.18	
Add disposal	1.49	
Total Direct	<u>61.67</u>	
55%	N/ Profit, overhead & Esc. 5.68	
	use \$6.00/cu. yd.	

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lake & Dam No.</u>
	<u>Excavation and Embankments</u>	FILE NO. <u>800A</u>
	COMPUTED <u>GJK</u> CHECKED _____	DATE <u>4/1/75</u> PAGE <u>2</u> OF <u>65</u>

Figure Disposal Costs for Various Distances

Truck cycle: 10 cy on-Highway Truck

	<u>1 mi</u>	<u>3 mi</u>	<u>5 mi</u>	<u>10 mi</u>
Load	5.0	5.0	5.0	5.0
Haul	4.0	10.0	15.0	24.0
Dump	3.0	3.0	3.0	3.0
Return	3.3	9.0	13.0	21.4
Lost	<u>0.7</u>	<u>1.0</u>	<u>2.0</u>	<u>3.6</u>
Total	18.0	28.0	38.0	57.0
Trips/Hr	2.8	1.8	1.3	0.9
Production cy/hr	28	18	13	9

Labor, w/OT	7.00	→		
Truck	<u>19.00</u>	→		
Direct Cost	\$ 26.80			
per cu yd	\$ 0.96	(1.49)	2.06	2.98

Add Flagmen separately

*Use this.
or \$2.30 w/Prof. O.H. & Esc.*

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Excavation and Embankments</u>	FILE NO. <u>800 A</u>
	COMPUTED <u>GJK</u> CHECKED <u>JR</u>	DATE <u>1/3/75</u> PAGE <u>3</u> OF <u>65</u> PAGES

Front end Loader excavation, for alluvial deposits and backfill excavation in open areas.

Say we'll use a 2 cy with a production of $2 \times 50 / .75 = 130$ cy/hr. Assume 30% dozer assistance.

Labor

1 FEL oper.		8.90
30% 1 Dozer oper.	8.70	2.60
2 Flag men		15.40
1 Misc Common		7.70
		<u>34.60</u>
W/OT (1.082)		37.50

Equipment

1 FEL 2 cy		15.00
30% 1 Dozer D-7	19.50	<u>5.85</u>
Total		20.85

SubTotal Direct

58.35

Per cy yd

0.45

Add Disposal

1.49

Total Direct

1.94

Profit & Overhead

0.67

W/Exc

.39

Use

\$ 3.00

Use this for acc. rd. removal

Sandstone

Use all as above but add full time dozer-ripper. Say production drops to 90 cy/hr

Labor & Equip above

58.35

add .7 Dozer op. W/OT

6.60

add ripper to D-7

3.00

Total

67.95

Per cu yd

0.76

Add Disposal

1.49

W/Profit & OH & Exc.

3.48

Use

\$ 3.50

(3/11/75) ✓
Note - for
small quant.,
close gtrs, use
\$ 15.00/cy

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COMPANY
CHICAGO

SUBJECT Cost Estimate
Excavation and Embankments
COMPUTED GJK CHECKED _____

PROJECT Lock & Dam No 1
FILE NO 800 A
DATE 1/2/75 PAGE 1 OF 65 PAGE

Clamshell excavation - for cofferdam removal and rock dike excavation.

Assume a 3 cy crawler crane loading trucks with 180° swing. $3 \times 50 / 0.90 = 166$; use 90 cu yds/hr per due to truck maneuvering.
(Using small on highway haul units)

Labor - operator 8.90

oiler 8.00

4 Flagmen 7.70 30.80

2 misc 15.40

62.10

W/O T 68.30

Equipment - Clamshell 54.20

Sub Total 122.50

Per cy 90 1.36

Add Disposal 1.49

Total 2.85

W/Profit & Overhead 3.84

W/Escalation 4.41

use 4.50 ✓

Double this for crib removal

Stripping - use same as FEL excavation.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Excavation and Embankments</u>	FILE NO <u>800 A</u>
	COMPUTED <u>GJK</u> CHECKED _____	DATE <u>1/2/75</u> PAGE <u>5</u> OF <u>65</u> PAGE

Figure Fill costs for Lock & Dam No. 1. Same assumptions as before. Assume all but random fill has to be purchased.

Access Road Random Fill

Say that 12,000 cy of this 19,000 cy fill can come from Land Wall backfill excavation.

The remainder will come from borrow say 8 mi away.

Placing only: say a D-8 w/ towed roller can place and compact 150 cy/hr.

Labor: { 1 Dumpman	8.35
W/OT { 1 Dozer oper	9.45
	<u>17.80</u>

D-8 Dozer	29.00
-----------	-------

Tow ^{ed} Sheepfoot Roller	1.20
------------------------------------	------

30.20

Total Direct	48.00
--------------	-------

per cy. yd. (150)	0.32
-------------------	------

Borrow and Haul and Place

from 8 miles truck production would be about 11 cy/hr/truck for 110 yd³/hr use 10 trucks

Labor 1 FEL op	8.90
----------------	------

10 Truck dr	72.00
-------------	-------

4 Misc Flagman	7.70
----------------	------

1 Placing crew	17.80
----------------	-------

129.50

Equipment

1 2cy FEL	15.00
-----------	-------

10 Truck 10 cy	190.00
----------------	--------

1 Dozer w roller	30.20
------------------	-------

235.20

Total Direct	364.70
--------------	--------

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>COST Estimate</u>	PROJECT <u>Lock & Dam No 1</u>
	<u>Excavation and Embankments</u>	FILE NO <u>800 A</u>
	COMPUTED <u>GJK</u> CHECKED _____	DATE <u>11/2/75</u> PAGE <u>6</u> OF <u>65</u> PAGE

Access Road Random Fill

B, H & P. Total Direct 364.70

per cy (2.110) 3.31

Composite Price

12/19 x 0.32 0.20

7/19 x 3.31 1.22

Composite Direct 1.42

w/ 35% Profit & OH 1.92

w/ 15% Esc 2.20

Use \$ 2.50 / cy

Use \$ 3.00 / cy for Access Ramp
for Land Cells

add \$ 3.00 for removal

Granular Cell Fill

Purchased material, barged from downstream 8 mi.

Local quote, say gravel & sand at \$ 200 / ton avg.

Say 15 ton / cy or 3.00 / cy

Hauling 8 mi $8 \times 15 \times 1.5 = 1.80 / cy$

Total mat'l 4.80 / cy delivered

Place by clamshell at 100 cy/hr

1 operator 8.90

1 oiler 8.00

1 misc 7.70

24.60

w/o T 26.65

1 clamshell 54.20

80.85

per cy 0.81

Add mat'l's 4.80

5.61

w/ Profit & OH 7.57

w/ Esc 8.70

Use \$ 9.00 / cy

remove @ 4.50

\$ 13.50

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No 1</u>
	<u>Excavation and Embankments</u>	FILE NO <u>800 A</u>
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	CHECKED _____	

Impervious Fill

Placed by clamshell from barges, spread by dozer
& roller. Say 100 cy/hour

Labor

1 Crane op	890
1 diler	800
1 Dozer op	870
1 Dumpman	710
2 Misc.	<u>1540</u>
	4870
W/OT	52.75

Equipment

1 Clamshell	54.00
1 DOZER	} 30.20
1 Roller	
2 gas tamper	<u>450</u>
	88.70
	141.45

Per cy 1.41

W/ material purchase 4.50

591

W/ Profit & Overhead 7.98

W/ Esc 15% 9.17

use \$ 9.00/cy + 3.00 for removal

Dumped Rock, Rip rap, Random Rock fill

Purchase & deliver \$ 9.00/cy

Place w clamshell 1.00

10.00

W/ Profit & overhead 13.50

W/ Esc 15.52

\$ 16.00/cy + 4.50 remove } when

Hand placed use \$ 25.00/cy + 4.50 remove } req'd.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No.</u>
	<u>Excavation and Embankments</u>	FILE NO <u>800 H</u>
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Gravel & Gravel Filters

Purchased & Hauled Placed by clamshell from barges
spread by Dozer & roller.

Purchase 6.00

Place 0.75

6.75

W/ Profit & OH 9.11

W/ Esc. 10.50

$10.50 + 3.00 = 13.50$ (removed) Use \$13.50 to incl. removal if req'd.

Back fill around Structures

Hand compacted material from excavation

Dozer placed, Production say 20 cy/hr

1 Dozer op 8.70

4 Cannon 30.80

39.50

W/OH 42.75

1 Dozer D-7 19.50

4 gas tamper 9.00

28.50

71.25

prcy 3.56

W/ Profit & OH 4.80

W/ Esc 5.53

Use \$6.00/cy

In larger back fill sites say 75% machine
compaction 25% hand compaction

Page 4 $.75 \times 0.32 = 0.24$

$.25 \times 3.56 = 0.89$

1.13

W/ Profit & OH 1.53

W/ Esc 1.75

say \$2.00/cy

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Steel Sheet Piling</u>	FILE NO. <u>800 A</u>
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1. Temp. Work

Sheet Piling

1) Drive, Pull & Salvage

Based on previous bidding experience and
Means Construction Cost Data 1975

Labor & Equip. to drive & extract	\$ 213.00/Ton
Piling etc. @ 75% salvage value	75.00
Waste allowance 10% of \$300.00	30.00
	<u>318.00</u>

(due to the fact that some may be driven from barge) } Add 20% for difficult conditions 62.00
Profit & Overhead 35% 133.00

Escal. 15% 77.00

\$ 590.00
Use 600.00/Ton

2) Drive & Leave in Place

Labor & Equipment to drive	142.00
Piling	300.00
	<u>442.00</u>

Prof & O.H. 35% 158.00

Escal 15% 90.00

\$ 690.00
Use \$ 700.00

3) Trim Piles \$ 200/lin.ft.

Pumping - Roughly \$ 350.00/day

Figure the cost of winter protection for Lock & Dam No. 1. Locks. Use current labor rates and material prices for Minneapolis from ENR. Use equipment hourly costs from CECRG. Add escalation at 15% per year for one year. (Construction will be in Nov, '75 as per DAB schedule). Use 25% of direct costs for contractor's profit & overhead.

The job will consist of erecting a column supported roof-truss over the locks, placing a wood and tar paper roof deck and enclosing the frame with canvas.

Crew sizes and production rates:

- Drillers - say an 8 man - layout, drilling and grouting crew can do about 40 ft. of drilling per hour. say 4 holes per column, 200 in ft deep or $51 \times 4 \times 4 = 816$ lin ft
Total job time $816/40 = 20.4$ hour say 2-8 hr days
- Steel Erection - use a crew of steel workers and equipment operators w/ truck crane to erect about 17 tons of steel per 8 hr day.
say $300/17 = 17.6$, 2 weeks, 6 days/week
- Wood & Tar Paper - use a crew of 7 men assisted by a crane to place 600 sq ft/hr
Total job time $510 \times (56 + 56 + 29)/600 = 120$ Hrs per crew, say $120/48 = 2.5$ wks total
- Canvas - say the wood & paper crew can do this work in a week
- Hauling: Assume that two trucks can bring in enough materials to keep up with production - $3\frac{1}{2}$ wks
- Total Job time $3\frac{1}{2}$ wks.

1) Drilling and Placing Anchor bars - say 3 days or 24hrs
Labor

2 Drillers	8.45	16.90
1 Helper		7.70
1 Air comp op		8.15
2 Grout & Bar men	7.70	15.40
1 layout man - misc.		7.70
O.T. for 6 day week $40 + (8.5 \times 8)$		55.85
Add 8.3%		60.50
For 24 Hrs		\$1452.00

Equipment

1 Air compr 250		9.00
2 Jackhammer	.35	0.70
1 Misc. grout tools		0.30
		10.00
For 24. Hrs		\$240.00

Materials

Threaded bars $1\frac{1}{2}$ " dia (arbitrary)		
6 #/FT \times \$.30/16 \times 816 =		\$1469.00
Drill steel .40/LF \times 816		326.00
Grout w/waste, 20 cuft., \$18/cuft.		360.00

Total Direct		\$3847.00
w/ Profit & CH 35%		5193.00
w/ ESC 15%	say	\$6000.00
(by 816) per lin. Ft.		\$7.34

2) Steel Erection - From Means & Stubbs, 17 Tons/hr
Labor

1 Foreman		12.00
4 St. Worker	9.95	39.80
90% 1 Crane op.	8.90	8.00
90% 1 Oiler	8.00	7.20
1 Compr op		8.15
2 Cannon	7.70	15.40
80% 2 Truck Dr.	7.20	11.50
		102.05

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock E' Dam No.</u>
	<u>Shelter for Winter Work</u>	FILE NO. <u>800 H</u>
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2) Steel Erection - cont'd

Labor per hr. 102.05
w/OT at 8.3% 110.50
for 3 wks, or 144 Hrs \$ 15,912.

Equipment 80% 2 Trucks 20.00 32.00
90% 1 Truck Crane 25 T. 17.00 15.30
1 Air Comp. 9.00
4 Torque Wrench 0.60 2.40
Misc. Clamps Hoses, Equip 1.30
60.00

for 18 days 144 Hrs 8,640

Materials

Roof Trusses, 164 tons or 328,000 #
at 28¢/lbs. x 328,000 91,840.
Struct. Beams .18¢/lbs. x 172,000 30,960.
Struct. Angles .20¢/lbs. x 100,000 20,000.
Bolts, etc. 1,484

Total Direct 534 \$ 170,000
w/ Profit & Overhead \$ 229,500
w/ Exc 15% 534 263,925 256,000.
534 - 265,000

3) Roofing - crew of 7 at 600 SF/hr - 2.5 wks.

Labor

1 Foreman 12.00
32% 1 Crane op 8.90 2.85 -
44% 2 Truck dr. 7.20 6.35 -
2 Carpenter 9.20 18.40 -
4 Common 7.70 30.80 -
32% 1 Oiler 8.00 2.55 -
72.95

w/OT at 8.3% 79.00
for 15 days, 120 Hrs \$ 9,480.

3) Roofing, cont'd

Labor		9480.
Equipment		
32% Crane	17.00	5.45
44% 2 Truck	20.00	17.60
Misc Tools		0.95
		<u>24.00</u>

for 120 Hrs 2880.

Materials

Lumber	143 MBF at \$220/mbf	31460.
Tar Paper	95,000 SF at \$7.00/100#	
15 #/sq, 95000 X 7.00 X .15/9		<u>11,050.</u>

Total Direct 54900
w/ Profit & OH & Esc. (about) \$ 85,000.

4) Canvas

Labor Crew above, 72.00 X 48	3504
Equipment - Crane 5.45 X 48	262
Materials, say 54/SF X 27,000	<u>1250</u>
	5116

w/ Profit & OH & Esc (about) \$ 8,000.00

5) Summary

1) Drilling	6,000.00 ✓
2) Steel Erection	265,000.00 ✓
3) Roofing	85,000.00 ✓
4) Canvas	<u>8,000.00 ✓</u>

Erection

\$ 364,000.00
say \$ 365,000.00

Removal - (see Page 5)

1 Anchor Bolts	650.00
2 Steel	(26,000.00)
3 Roofing	20,000.00
4 Canvas	<u>3000.00</u>

Total Job \$362,000 (2350.00)

Removal

1) Anchor Bolts - 40 Bolts/hr

Labor - 2 Common	7.70 x 1.083	16.70
Equipment - Cutting Torch		0.50
Grinder		0.15
Hourly Total		17.35 \$/hr
W/ Profit OH & Esc		27.00 \$/hr
for 24 Hrs	504	\$650.00

2) Steel Framing - say the steel crew can dismant. about 25 tons/day, assisted by a crane, say steel will be sold to buyer who picks it up on site at 30% Purchase Price.

Labor - steel crew w/ Truck dr.	90.55
W/ OT	95.00
Equipment - No Trucks	28.00
Subtotal	126.00
For 300/25 = 12 days	12,096
W/ Profit & Overhead & Esc.	18,780
Steel Salvage	
148,800 x .30 =	(44,640)
Net Salvage	(25,860)
	say (26,000)

3) Roofing - mean's says 4 Laborers can remove 4000 BF/day - 8hr. use 10 for 10,000 BF, 145/10 = 15 days or 120 Hrs. say

Labor 1 Foreman	12.00
10 Common	7.70 77.00
20% Crane op	8.90 1.80
20% Oiler	8.00 1.60
	92.40
W/OT	\$100.00/hr
Equip. 20% Crane	3.40
Misc.	1.60
Total	\$105.00
W/ Profit OH & Esc	163.00
4 Canvas - 50% labor & equip. for 120 Hrs	504 19,560
	\$20,000

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u> <u>Shelter for Winter Work</u> COMPUTED <u>JAT</u> CHECKED _____	PROJECT <u>Lock & Dam No. 1</u> FILE NO <u>800 A</u> DATE <u>1/7/75</u> PAGE <u>15</u> OF <u>65</u> PAGES
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Heat Temporary Shelter

2,200,000 cu.ft. — poorly insulated. 5 months

Assuming a well insulated area costs about \$0.025 per cu.ft., the poorly insulated shelter might cost \$0.10/cu.ft. for the 5 months

or use \$250,000.00 Plan No. 1
Double for Plan No. 2

Lighting & Pumping — use \$10,000 for each.

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SUBJECT Cost Estimate
Removal of Concrete
COMPUTED JAT CHECKED _____

PROJECT Lock & Dam No. 1
FILE NO 800 A
DATE 1/10/75 PAGE 16 OF 65 PAGES

Removal of Existing Concrete -

This material must be drilled and light blasted
— generally from bottom to top in the case of new
conduit excav. Compute typical round of 3.5'

Cross sec 120 sq. ft.

No. of drill holes use 60 @ 4' depth = 240'

Drill time - with 4 drills =

@ 0.6 min./drill $\frac{240}{2.4} = 100 \text{ min}$

(vol./round = $(10 \times 12 \times 3.5) \div 27 = 58 \text{ yd}$)

load & shoot $60 \times 2 \div 2$ (2 men) 60

muck out 30

set up drills 30
220 min

Cost/round: = 3.66 hrs — use 4.5 hrs

Labor:

drillers, powdermen, front
end loader oper., welder for
old rebars, compressor oper.,
truck driver, other labor

say $15 @ 8.00 \times 4.5 = 540.00$

Equipment about 900/hr = 405.00

Materials

Drill steel, bits, explosives 80.00

Total 1,025.00

$\frac{1,025 \times 1.35 \times 1.15}{15} = \106

Use 110.00/cu. yd.

Use this for conduit excav. and enlarging
conduits

Removal of concrete — not involving tunnel oper. —

— use \$65.00/cu. yd.

For Gate Slots involving mostly air hammer work \$150.00/cu. yd.
Same for 3.5' roof depression

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Slurry Trench</u>	FILE NO <u>800 A</u>
	COMPUTED <u>JAT</u> CHECKED _____	DATE <u>1/13/75</u> PAGE <u>18</u> OF <u>65</u> PAGE

Drains - Perf. Clay Pipe (Means Constr. Cost Data '75)
 12" $\$4.70 \times 1.35 \times 1.15 =$ say $\$6.00/\text{ft.}$

24" Use $\$15.00/\text{lin. ft.}$

Slurry Trench

180 cu yd.

Excavation, Slurry and Earth Backfill usually
 costs about 1.50 to 2.50 /cu.ft.

Use $\$2.00 \times 180 \times 27 = \$9,720$

add concrete - Pg. 31:

$180 \times 80 = 14,400$

$\$24,120$

$24,120 \div 180 =$ say $\$130.00/\text{c.y.}$ to 135.00
 Use $\$10,000$ for shelter

Air Vents

(12") Drill hole 100' @ 60.00 (incl. setup) = 6,000

Casing 40' @ 25.00 = 1,000

Grouting = 3,000

Prof., O.H. & Escal. incl. $\$10,000$

Unit price $\$100.00/\text{ft.}$

Misc. Connections $\$5,000$

Valve operating Structures

Remove Existing @ $\$1,000.00$

New Construction @ $\$2,500.00$

Remove Existing Control Structure $\$10,000$

Construct New Control Structure

All prices other than concrete from 1975 Means
 Constr. Cost Data.

Misc. Metalwork $\$1.25/\text{lb}$ (Grills)

Misc. Steel $\$1.00/\text{lb}$

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>LANDSCAPING LOCK & DAM No. 1</u>	PROJECT <u>L & D No. 1</u>
	<u>cost estimate</u>	FILE NO <u>80DA</u>
	COMPUTED <u>SOS/SLK</u> CHECKED <u>JS</u>	DATE <u>12-1-74</u> PAGE <u>19</u> OF <u>65</u> PAGES

NOTE: Landscaping of land adjacent to Lock & Dam No. 1 shall consist of planting sod, trees, and shrubs to enhance the aesthetic appearance of the site.

List of Species

Trees

Acer rubrum - red maple

Acer saccharum - sugar maple

Shrubs

Juniperus chinensis pfitzeriana - Pfitzer juniper

Juniperus virginiana globosa - Globe juniper

Taxus cuspidata nana - Dwarf japanese yew

Sod

Perfect sod

Quantity	Scientific Name	Height	Caliper	Condition	Firm's Nursery Unit Price	Install.	Transportation ³¹	Total Price
<u>Trees</u>								
4	<i>Acer rubrum</i> > 12"	5"	BB		\$ 190	124 ¹¹	19.00	Per tree \$ 355 ³¹
4	<i>Acer saccharum</i> > 18"	5"	BB		225	146 ¹¹	22.50	393 ³¹
<u>Shrubs</u>								
10	<i>Juniperus chinensis</i> p.	4'	-	BB	23 20	17.00 ³¹ 10.00	2.00	42.00 32 ³¹
10	" <i>virginiana</i> , g.	3'	-	BB	27	19.00 ³¹ 13.50	2.70	46.70 ³¹
10	<i>Taxus cuspidata</i> n.	3'	-	BB	24 ✓	12.00 ³¹	2.40	38 ³¹
<u>Sod</u>								
600 yds ²	Perfect sod	-	-	-	2.70 2.00	1.60 1.50	.20	2.00 2.70

11 Installation 65% of material cost MEANS

Installation 50% of material cost MEANS

31 Transportation 10% of material cost MEANS

HARZA
ENGINEERING
COMPANY
CHICAGO

SUBJECT Landscaping costs

COMPUTED 505/GJK CHECKED [Signature]

PROJECT L&D No. 1

FILE NO. FOOA

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<u>Scientific Name</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total Price</u>		
<u>Acer Rubrum</u>	<u>4</u>	<u>333.⁰⁰</u>	<u>1332</u>	<u>✓</u>	<u>1332</u>
<u>Acer Saccharum</u>	<u>4</u>	<u>393.⁵⁰</u>	<u>1574</u>	<u>✓</u>	<u>1574</u>
<u>Juniperus chin.</u>	<u>10</u>	<u>42.⁰⁰</u>	<u>420</u>		<u>42.00 420</u>
<u>" virginiana</u>	<u>10</u>	<u>48.70</u>	<u>487</u>		<u>48.70 487</u>
<u>Taxus cuspidata</u>	<u>10</u>	<u>38.40</u>	<u>384</u>		<u>38.40 384</u>
<u>500</u>	<u>600 yds</u>	<u>3.⁷⁰</u>	<u>2220</u>		<u>4.00 2400</u>
			<u>6262</u>		<u>6597</u>
<u>Contractors Profit & Overhead @ 35%</u>			<u>2191.70</u>		
			<u>8453.70</u>		<u>8905</u>
					<u>USE \$9,000</u>

Figure the Cost of pulling, storing and replacing
5 Elm trees at Lock & Dam No 1.

Say procedure is as follows:

- 1) Cut roots at 10 FT radius to 3 FT depth,
say, 3 FT wide trench. Backfill.
- 2) Remove using a Crawler Crane and 2
large front end loaders and a 4 man
labor crew for one day per tree
- 3) Maintain and water during construction period
say 7 man-hours/wk avg.
- 4) Excavate, Return, Replace, same crew as
before, same time.
- 5) Maintain for 6 mo. at 7 man-hr/wk.

- 1) Cut Roots, say 3x3 trench for $3.14 \times 20 = 60$ FT
 $5 \times 3 \times 3 \times 60 / 27 = 100$ cu yds.

Use Backhoe & Operator for $\frac{1}{2}$ day due
to tight quarters

Labor	8.90	$\times 1.002(OT) \times 4$	38.55
Equip	25.00	$\times 4$	100.00
			<u>138.55</u>

Backfill, say 2 hours same as above

69.27
207.82

W/Profit & Overhead 35% 280.55
Use \$ 300.00

- 2) Remove - 5 days - 40 Hrs

Labor

1 Foreman	11.00	11.00
3 Equip op	8.90	26.70
4 Labor	7.70	<u>30.80</u>
		68.50

W/OT 1.003 74.19

Equipment: 1 Crane 150 Ton 60.00
2 FEL Cat. 992 160.00

Total All 294.19

W/Profit & OH for 40 Hrs 15,886.26 \$16,000

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam 1</u>
	<u>Landscaping</u>	FILE NO. <u>800 A</u>
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3) Maintain - 7 man-hours/wk + materials
for \approx 2 years

Labor: $7 \times 2 \times 52 \times 7.70 \times 1.083 = 6070.00$

Equip: Pump, Hoses $728 \times 1.00 = 728.00$

Materials: Mulch, 3000 SF say 4 times in
2 year $12000 \text{ SF} \times 0.15$ 1800.00

8598.00

W/ Profit & OH 35% 11607.00

say \$ 11,700.00

4) Return - same as #2 16,000.00

5) Maintain - 6 mo. $11700/4 \approx$ \$ 3,000.00

Total

\$ 47,000

Use

\$ 50,000

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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The initial estimates for the various schemes (Jan. 17, 1975) were covered in our "Back-Up Computations" pages 1-21 inclusive. These prices, in some cases were rather carefully calculated, and others were based on bidding experience. Since the cost estimates will influence the selection of a scheme, all of the unit prices should be reviewed. Certain of the prices should be calculated in more detail with respect to prevailing working conditions, rates of production and construction methods which may be used. These notes are intended to cover any items, the unit prices of which may be questionable.

1. Consider all concrete work:

Plans 1 & 4 These plans would be scheduled to be accomplished during 5 winter or near winter months. Weather conditions will slow the production rate. The heated shelter will not cover the discharge or intake manifolds, so that production for these features will be slower and costs higher. Because of weather & the work quantity, Plan 4 could be expected to be the most costly and Plan 1 nearly as costly as Plan 4.

Plan 2 Some of this work will be done in winter and most of it in summer and fall. One might expect these concrete costs to be somewhat less than similar work for Plan 1.

Plan 3 Since navigation would be halted, all work could be done in spring, summer and fall for the cheapest price.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO <u>800 A</u>
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1. Concrete Work, Cont'd.

Assume that a typical concrete placement crew will consist of the following

		Shifts	Shift:
		2@10hr	@10
Labor	rate	amt	
1 Foreman	10.35	10.35	
1 Crane Operator 50%	9.00	9.00	
1 Pumpcrete Operator	7.75	7.75	
1 Compressor Operator	7.75	7.75	
2 Vibrator men	7.75	15.50	
1 Form Checker	8.00	8.00	
1 Finisher	8.00	8.00	
3 Laborers	7.00	21.00	
Subtotal		87.35	87.35
* Shift diff. & Overtime allowance 22.5%:		19.65	17% 14.65
Total Labor		\$ 107.00	102.00

Equipment

(15T) 1 Truck Crane 50%	13.00	6.50	see ① page 25
1 Compressor	9.00	9.00	
1 Pumpcrete	16.00	16.00	
2 Vibrators	0.50	1.00	
Misc. Tools		2.50	
Total Equipment		\$ 35.00/hour	

Cost of crew, Labor & Equipment \$ 142.00 or \$ 137.00

Materials

Concrete, ready mix - delivered, use \$27.00/cu. yd. (② page 25.)
 Reinforcing steel — use \$0.25/lb. (direct cost.
 with mark-up total bid would be \$0.39/lb. —
 including ironworker's time).

Note: Concrete work will be divided into categories with varying rates of production and quantities of reinforcing steel.

* Assume 2@10 hr. shifts/day, 6 days/wk

$$\frac{\text{hrs. prod}}{\text{hrs. worked}} = \frac{[(40 \times 1) + (20 \times 1.5)] + [(40 \times 1.1) + (20 \times 1.5 \times 1.1)]}{60 + 60} = 1.225$$

and $(40 + 39) \div 60 = 1.17$ for 1@10 hrs/day, 6 days/wk.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO <u>B00 A</u>
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1. Concrete Work, Cont'd

We will figure on 10 hour shifts, 6 days per week.
 Double shift to be used where schedule is tight.
 We have used single shift rates for equipment, even though the double shift rate is somewhat cheaper.
 Under average conditions, the above crew should place from 5 to 7 cu.yds of concrete per hour while actually placing concrete.

From Page 23

Cost for double shift crew = \$142.00/hr

Cost for single shift crew = \$137.00/hr

(Composite for Plan 2 - about \$139.00/hr)

We will assume the following average production rates per crew hour:

- ① (Page 24). Truck Crane, 15 Ton, price from C.E.C.R.G. (Grove TM 15 Ton - \$14.49/hr on 20 hour day.)
- ② (Page 24). Concrete price \$27.00/c.y. for 3000 psi concrete. ENR March 6, 1975 price \$23.50 + 15% heat and waste = \$27.00/c.y.

These averages have been adjusted for the various categories of concrete, job conditions, etc:

	cubic yards per hour			
	P L A N No.			
	1	2	3	4
New Manifolds & Conduits	4.25	4.5	5.5	4.0
Slots	2.0	2.0	2.0	1.7
Fill Gate Slots & Conduit	8.0	10.0	10.0	7.5
Walls	6.0	8.0	10.0	5.5
Slabs & Footings	8.0	10.0	10.0	7.5
Slurry Trench	8.0	8.0	8.0	7.5
Fill Shear Keys	6.0	8.0	8.0	5.5
Bridge & Control House	5.0	7.0	7.0	4.5
Misc.	2.0	2.0	2.0	1.5

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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Tabulation of concrete type volumes.

	PLAN	No.		
	1	2	3	4
1. New Manifolds + Conduits				
Discharge man. downstr. of land lock	900	900	900	900
" " " " river "	900	900	900	1,350
Intake manifold:				
Upper guide wall	800	800	800	800
Land wall	60	60	60	60
Intermediate wall	1,100	1,100	1,100	1,650
River wall	0	0	0	1,100
Discharge manifold:				
Lower guide wall	1,300	1,300	1,300	1,300
Intermediate wall extension	2,500	2,500	2,500	4,150
River wall extension	0	0	0	3,000
Other:				
Rebuilt ports for land wall	130	130	130	130
New ports for intermediate wall	110	110	110	110
Total	7,800	7,800	7,800	15,110
2. Slots				
New bulkhd. gate slot for land wall	35	35	35	35
" " " " "interm. "	35	35	35	70
" " " " "river "	0	0	0	35
Total	70	70	70	140

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock + Dam No. 1</u>
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PLAN NO.

1 2 3 4

B. Fill Gate Slots + Conduit

Lowered conduit for land wall	400	400	400	400
Fill gate slot " " "	40	40	40	40
Existing conduit " " "	200	200	200	200
Depress cond. cost " " "	300	300	300	300
Fill exist. gate slot " " "	300	300	300	300
Lowered conduit for intermediate wall	400	400	400	800
New fill. gate slot " " "	40	40	40	80
Existing conduit " " "	200	200	200	200
Depress cond. cost " " "	300	300	300	600
Close old ports " " "	40	40	40	80
Fill exist. gate slots " " "	300	300	300	600
Lowered conduit for river wall	0	0	0	400
Fill gate slot " " "	0	0	0	40
Existing conduit " " "	0	0	0	200
Depress cond. cost " " "	0	0	0	300
Conduit ports " " "	0	0	0	130
Fill exist. gate slots " " "	0	0	0	300
Total	2,520	2,520	2,520	4,970

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>BDD A</u>
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	PLAN NO.			
	1	2	3	4
4. Walls				
River guide wall monolith	0	0	0	370
Total	0	0	0	370
5. Slabs & Footings				
Upstream apron slab (2' thick)	1,400	1,400	1,400	1,400
Land wall footings	14	14	14	14
Repair of concrete surfaces	900	900	900	900
Total	2,314	2,314	2,314	2,314
6. Slurry trench				
Discharge manifold slurry trench	180	180	180	260
Total	180	180	180	260
7. Fill shear Keys				
Intermediate wall (reinforced)	26	26	26	26
River wall	0	26	0	26
Total	26	52	26	52

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HARZA ENGINEERING COMPANY CHICAGO	SUBJECT	Cost Estimate	PROJECT	Lock & Dam No. 1
		Concrete	FILE NO.	800 A
	COMPUTED	SMA	CHECKED	gx
			DATE	3/7/75 PAGE 29 OF 65 PAGES

	PLAN NO.			
	1	2	3	4
B. Bridge & Control House				
Bridge & elevator	220	220	220	220
Control house	400	400	400	230
Total	620	620	620	450
P. Miscellaneous				
Dead men	20	20	20	20
Land wall cribbing	20	20	20	20
Cable trenches for land wall	7	7	7	7
Mooring bits " " "	140	140	140	140
Cable trenches for interm. wall	7	7	7	14
" " " river "	0	0	0	7
Fill inclined shaft in dam	15	15	15	15
Total	209	209	209	223
TOTAL OF ALL CONCRETE	13,739	13,765	13,559	23,809

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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Computation of Average Productivity

WORK TYPE	PLAN NO.			
	1	2	3	4
1. New Manifolds & Conduits				
yd ³ /hr	4.25	4.5	5.3	4.0
yd ³	7,800	7,800	7,800	15,110
crew hours	1,835	1,733	1,472	3,777
2. Slots				
yd ³ /hr	2.0	2.0	2.0	1.7
yd ³	70	70	70	140
crew hours	35	35	35	82
3. Fill Gate Slots & Conduit				
yd ³ /hr	8.0	10.0	10.0	7.5
yd ³	2,520	2,520	2,520	4,970
crew hours	315	252	252	663
4. Walls				
yd ³ /hr.	6.0	8.0	10.0	5.5
yd ³	0	0	0	370
crew hours	0	0	0	67
5. Slabs & Footings				
yd ³ /hr.	8.0	10.0	10.0	7.5
yd ³	2,314	2,314	2,314	2,314
crew hours	289	231	231	309
6. Slurry Trench				
yd ³ /hr.	8.0	8.0	8.0	7.5
yd ³	180	180	180	260
crew hours	22	22	22	35
7. Fill Shear Keys				
yd ³ /hr.	6.0	8.0	8.0	4.5
yd ³	26	52	26	52
crew hours	4	7	3	12

FOR USE ON U.S. GOVERNMENT WORK ONLY

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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WORK TYPE	PLAN NO.			
	1	2	3	4
8. Bridge & Control House				
yd ³ /hr	50	7.0	7.0	4.5
yd ³	620	620	620	450
crew hours	124	89	89	100
9. Miscellaneous				
yd ³ /hr.	2.0	2.0	2.0	1.5
yd ³	209	209	209	223
crew hours	105	105	105	149
TOTAL CREW HOURS	2,729	2,474	2,209	5,194
TOTAL CONCRETE (yd ³)	13,739	13,765	13,559	23,889
AVG. PRODUCTIVITY (yd ³ /crew hour)	5.03	5.56	6.13	4.59
	5.0	5.6	6.1	4.6

These weighted averages are reasonable

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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Concrete Work, Cont'd

Plan 1. About 13,740 cu.yds. of concrete. (all double shift)

Description	① cu.yds. placed per hr.	② Concrete at site per cu.yd.	③ Place, Vibrated Finish	④ Re-Steel @ \$0.25 per lb.	⑤ Total Direct cost	⑥ Price per cu.yd. w/ Profit & c. (rounded)
New Manifolds & Conduits	4.25	27.00	142.00	85.00	80.41	125.00
Gate Slots	2.0	27.00	142.00	40.00	118.00	185.00
Fill Gate Slots & Conduits	8.0	27.00	142.00	60.00	52.25	80.00
Walls	6.0	27.00	142.00	45.00	58.16	90.00
Slabs & Footings	8.0	27.00	142.00	120.00	59.75	95.00
In Slurry Trench	8.0	27.00	142.00	60.00	52.25	80.00
Fill Shear Keys	6.0	27.00	142.00	150.00	75.66	115.00
Bridge & Control House	5.0	27.00	142.00	220.00	99.40	155.00
Misc	2.0	27.00	142.00	80.00	138.00	215.00

Plan 2 About 13,770 cu.yds. of concrete (30% double shift and 70% single shift.

New Manifolds & Conduits	4.5	27.00	139.00	90.00	77.88	120.00
Gate Slots	2.0	27.00	139.00	40.00	116.50	180.00
Fill Gate Slots & Conduits	10.0	27.00	139.00	75.00	48.40	75.00
Walls	8.0	27.00	139.00	60.00	51.87	80.00
Slabs & Footings	10.0	27.00	139.00	150.00	55.90	85.00
In Slurry Trench	8.0	27.00	139.00	60.00	51.87	80.00
Fill Shear Keys	8.0	27.00	139.00	200.00	69.37	110.00
Bridge & Control House	7.0	27.00	139.00	308.00	90.85	140.00
Misc.	2.0	27.00	139.00	80.00	136.50	210.00

$$⑤ = \frac{[(① \times ②) + ③ + ④]}{①}$$

$$⑥ = 1.35 \times 1.15 \times ⑤$$

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Concrete</u>	FILE NO. <u>800 A</u>
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Concrete Work, Cont'dPlan 3 About 13,560 cu.yds. of concrete (all single shift

	cu.yds placed per hr	Concrete at site per cu.yd.	Place, Vibrate and Finish	Re Steel @ \$0.25 per lb.	Total Direct Cost	Price per cu. yd. w/profit & G.H. & escal. (founder)
New Manifolds & Conduits	5.3	27.00	137.00	106.00	72.84	115.00
Gate Slots	2.0	27.00	137.00	40.00	115.50	180.00
Fill Gate Slots & Conduits	10.0	27.00	137.00	75.00	48.20	75.00
Walls	10.0	27.00	137.00	75.00	48.20	75.00
Slabs & Footings	10.0	27.00	137.00	150.00	55.70	85.00
In Slurry Trench	8.0	27.00	137.00	60.00	51.62	80.00
Fill Shear Keys	8.0	27.00	137.00	200.00	69.12	105.00
Bridge & Control House	7.0	27.00	137.00	308.00	90.57	140.00
Misc.	2.0	27.00	137.00	80.00	135.50	210.00

Plan 4 About 23,890 cu.yds. of concrete (all double shift,

New Manifolds & Conduits	4.0	27.00	142.00	80.00	82.50	130.00
Gate Slots	1.7	27.00	142.00	34.00	130.52	200.00
Fill Gate Slots & Conduits	7.5	27.00	142.00	56.00	53.40	85.00
Walls	5.5	27.00	142.00	41.00	60.27	95.00
Slabs & Footings	7.5	27.00	142.00	113.00	61.00	95.00
In Slurry Trench	7.5	27.00	142.00	56.00	53.40	85.00
Fill Shear Keys	5.5	27.00	142.00	138.00	77.90	120.00
Bridge & Control House	4.5	27.00	142.00	198.00	102.55	160.00
Misc.	1.5	27.00	142.00	60.00	161.66	250.00

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT	Cost Estimate	PROJECT	Lock & Dam No. 1
		Sand Fill in Main Dam	FILE NO.	800 A
	COMPUTED	JAT	CHECKED	SMA
			DATE	3/6/75 PAGE 84 OF 65 PAGES

Cost of Pumping Sand Into Main Dam Cavity.

(Originally this was planned as lean concrete)

- a) Work consists of clearing each 6" ϕ relief hole by hand excavation inside of dam, then place wire mesh against opening and fill (2 \pm cu. ft.) of gravel to provide drainage after sand is pumped in.

2 per 16' bay = 72 holes

Assume 6 holes per 8 hr day, Total hrs = 96

Use 100 hrs

Labor

Foreman

8.40

3 laborers

21.00

29.40 \times 8 = 235.20

Equipment

Wheel barrow, etc.

2.00 \times 8 = 16.00

Mat'l

Gravel

4.00

1350' Screen $\frac{1}{2}$ " mesh (0.35)

4.72

Mat'l

8.72

8.72

Total = Per day

259.92

(259.92 \div 6) \times 72 = \$3,119 direct cost

- b) Fill in by pumping 5000 cu. yds. of mixture of sand and water, use pump similar to pumpcrete capable of 25 cu. yds/hr. With delays figure job can be done at average of 15 cu. yds/hr or say 320 hours. Assume sand can be dumped onto draft tube deck by truck @ \$6.00/cu. yd. Small (Bobcat) dozer will move material to small mixer where sand is mixed with water pumped from tailrace. Mixture then pumped into dam through 6 inch pipe.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Sand Fill in Main Dam</u>	FILE NO. <u>500 A</u>
	COMPUTED <u>JAT</u> CHECKED <u>SMA</u>	DATE <u>3/6/75</u> PAGE <u>35</u> OF <u>65</u>

Cost of Pumping Sand Into Main Dam Cavity

Cost

Labor

Foreman	10.50
Dozer (Bibco) Oper.	8.70
Water Pump Oper	7.75
Mixer Oper	7.75
Pump Oper	7.75
4 Laborers	<u>28.00</u>
Labor / Hr	70.45

Equipment

Dozer	5.00
Pumps & mixer	<u>30.00</u>
Equip / hr	35.00

Materials

Sand 15 cy @ 6.00	90.00
Pipe rental	<u>3.00</u>
Mat'l / hr	93.00

Total per hour 198.45

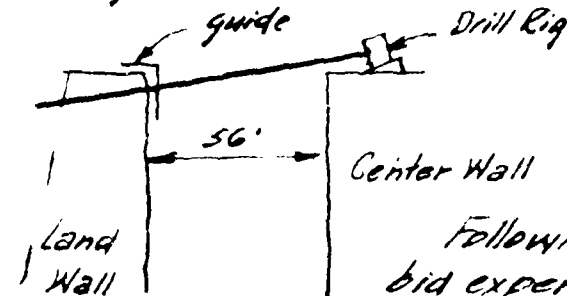
$$[(198.45 \times 320) + 3119] \times 1.35 \times 1.15 = \$103,432$$

$$\text{Per cu. yd. } (\div \text{ by } 5,000) = \$20.68$$

Say \$21.00 / cu. yd.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lodge Dam No. 1</u>
	<u>Rock Anchors</u>	FILE NO <u>800 A</u>
	COMPUTED <u>JAT</u>	CHECKED <u>SMA</u>
	DATE <u>3/6/79</u> PAGE <u>36</u> OF <u>65</u> PAGES	

Cost of Rock Anchors for Stabilization of Land Wall



Following prices are either from bid experience or worked out.

Alt. 1 (1 3/8" single anchors)

a) Setup drill - 6 hrs

Labor

1 Driller 8.00 8.00

2 Helpers 7.00 14.00

22.00/hr x 6 = 132.00

Place guide, and support
for drill rig. L.S.

100.00
232.00

$232 \times 1.35 \times 1.15 = \360.18

To allow for moving drill to
center wall and removal of guides
and supports, use per setup \$400.00

b) Drilling Holes

Drill & Crew costs about \$30.00/hr

Use 5 ft/hr for drilling

$\frac{30 \times 1.35 \times 1.15}{5} = \$10.00/\text{lin. ft.}$

c) for Core Recovery use \$10.00/lin. ft.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Rock Anchors</u>	FILE NO <u>800 A</u>
	COMPUTED <u>JAT</u> CHECKED <u>SMA</u>	DATE <u>3/6/75</u> PAGE <u>37</u> OF <u>65</u> PAGES

Cost of Rock Anchors, Cont'd.

- d) Place Grout & tension Anchor Bars
Figure total time per Anchor @ 8 hrs

Labor

Foreman	10.50
Welder 50%	4.50
Grout Pump Oper	8.00
3 Laborers	21.00
	<u>\$44.00/hr</u>

Equipment

Grout Pump, Welding Equip. & Misc.	15.00
Labor & Equip	$8 \times 59.00 = 472$

Material

90' of bar with fittings	160.00
Grout 44 cu.ft. @ 2.00 (384)	<u>10.00</u>
Material/hole	<u>170.00</u>
	<u>170</u>
	<u>642</u>

$$\frac{642 \times 1.35 \times 1.15}{90} = 11.07$$

Use \$11.00 / lin. ft.

Alt. 2 1 1/4" Double Anchors

- a) Set up - same as Alt. 1 = \$400.00

- b) Drilling Hole 4"

Production might be slightly slower than Alt. 1.
Use \$12.00 / lin. ft.

- c) Core Recovery, Same as Alt. 1 \$10.00 / lin. ft.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Rock Anchors</u>	FILE NO <u>Sec A</u>
	COMPUTED <u>JAT</u> CHECKED <u>SMA</u>	DATE <u>9/2/75</u> PAGE <u>38</u> OF <u>65</u> PAGES

Cost of Rock Anchors Cont'd.

Alt. 2, Cont'd (1 1/2" Double Anchors)

d. Place, Grout & Tension Anchor Bars

Figure time for 2 @ 95' bars @ 10 hrs

Labor (Alt. 1) $44.00 \times 10 = 440.00$ Equipment $15.00 \times 10 = 150.00$

Bars

 $95 \times 2 \times 4.172 @ \$0.35 = 277.43$ Grout 8.3 cu.ft. @ \$2.00 16.60 $294.03 \text{ say } 300.00$

Total

890.00 $890 \times 1.35 \times 1.15 = \14.54

95

Use \$15.00/lin.ft.

Alt. 3 1 1/2" Triple Anchors

a) Set up - same as Alt. 1 & Alt. 2 \$400.00

b) Drill 5" hole

Use 3'/hr. same hourly cost

as Alt. 1

 $30 \times 1.35 \times 1.15 = \15.52 use \$16.00/ft.

3

c) Core Recovery use \$10.00/ft.

d) Place, Grout & Tension Anchor Bars

Figure 3 @ 100 bars @ 14 hrs

Labor (Alt. 1 & 2) $44.00 \times 14 = 616.00$ Equipment $15.00 \times 14 = 210.00$ Bars $3 \times 100 \times 4.172 \times \$0.35 = 438.00$ Grout 13.66 cu.ft. @ \$2.00 27.32 $\$465.32$ 465.00\$1291.00 $1291 \times 1.35 \times 1.15 = \20.04

100

Use \$20.00/lin.ft.

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Shear Keys</u>	FILE NO <u>800 A</u>
	COMPUTED <u>JAT</u>	CHECKED <u>SMA</u>
	DATE <u>3/25/75</u> PAGE <u>39</u> OF <u>65</u> PAGES	

Compute costs of Shear Keys

a) Drilling, Vertical Holes - use rotary drill.

Costs	While Drilling (Equip. Depr. & Op.)	While Setting Up (Equip. Depr.)
Labor		
1 Foreman	10.35	10.35
1 Drill Operator	9.00	9.00
2 Helpers	7.00	7.00
1 Pump operator	7.75	7.75
Subtotal	34.10	34.10
17% S.D. & D.T.	5.90	5.90
Labor per Hr.	40.00	40.00

Equipment

1 Drill	35.00	15.00
1 Pump	5.00	1.00
Bit cost	5.00	-
Equipment/hr	45.00	16.00

Total Per Hr	85.00	56.00
W/35% Profit & O.H. + 15% Escal.	47.00	31.00
Total/Hr	132.00	87.00

Production 1 ft/hr avg. \$132.00/lin.ft.
Use \$140.00/lin.ft.

Setup time incl. move in &
move out, average

3 hrs

Cost of move & set-up

384 \$250.00

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Cost Estimate</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Shear Keys</u>	FILE NO. <u>800A</u>
	COMPUTED <u>JAT</u>	CHECKED <u>SMA</u>
	DATE <u>3/25/75</u> PAGE <u>40</u> OF <u>65</u> PAGES	

Shear Keys, Cont'd.

b) Drilling Horizontal Holes use - jackhammers

The drilling will be done from moveable scaffolding. Hole pattern will be drilled such that inner core of concrete can be removed without blasting.

This will involve considerable drilling. The opening desired should be equivalent of 2' ϕ hole or 3' - could be square of say 22". Figure cost one opening which will require about
 $6' \times 11' \times 4' = 264 \text{ lin.ft. to drill}$

Assume avg. production @ $\frac{1}{2}'/\text{minute}$; Total drill time 8.8 hrs. At 75% efficiency use 12 hrs. for drill time only.

Scaffolding would be moveable and required for other operations as well, such as wall clean up, shotcrete, etc. Prices for these items are considered high enough to include scaffolding which would cost say about \$2,500.00 per wall surface, or about \$10,000.00 for the job, on a rental basis.

Drill one opening & remove material

Labor $[(1.7 \times 1.7 \times 6) \div 27] = \text{about } 0.7 \text{ cu.yd.}$

Foreman	9.30
1 driller	7.75
1 helper	7.00
1 compr. oper	7.75
Subtotal	31.80
17% SD & OT	5.40

$$37.20 \times 12 = 446.40$$

$$\text{Equipment } 10.00 \times 12 = 120.00$$

remove 0.7 cu.yd @ 5.00

$$3.50$$

$$\underline{\$569.90}$$

W/35% Profit & Overhead & 15% escalation

$$\underline{\$883/\text{opening}}$$

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CHICAGO

SUBJECT Cost Estimate
Shear Keys - Vents
COMPUTED JAT CHECKED SMR

PROJECT Lock & Dam No. 1
FILE NO 800 A
DATE 3/25/75 PAGE 41 OF 65 PAGES

Shear keys

Cost of one horizontal hole = \$ 883.00
(this does not include scaffolding)

We have 16 holes.

Assume 30% of scaffolding rent is
charged to these holes

$$\frac{.30 \times 10,000}{16} = 187.50$$

Total/hole \$ 1070.50

Cost per hole, use \$ 1200.00

or \$ 200.00/lin. ft. for excavation

Enlarge Vent system

Set up over hole - Page 3B of 63 \$ 250.00

Drill 3'-0" dia hole

Assuming .85'/hr - Page 3B of 63 \$ 165.00

Pipe @ 75¢/lb

Misc. Connections, etc use 10% of pipe cost

for excavation and backfill use \$ 10.00/c.y.

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOISProject Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 42 of 65 Pages
Structure Discharge Manifolds with Stilling Basin East of River Wall Estimated by JAT/VT Checked by VT

Item No.	ITEM	Quantity	Unit Price	Amount
	<u>PLAN No. 4A</u>			\$ U.S.
	Removal of Slab and Apron; Pg. 5 of 20 of Estimate			72400
	Lower Guide Wall; Pg. 5 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			249250
	Laterals Downstream of Landward Lock; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			206935
	Intermediate Wall Extension; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			310900
	Laterals Downstream of Riverward lock; Pg. 7 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			215120
	<u>Subtotal</u>			<u>1054605</u>
	<u>Stilling Basin</u>			
	Excavation, Alluvium	2,000 c.y.	65.00	6000
	Remove Concrete Slab	130 c.y.	65.00	8450
	Gravel Filter	150 c.y.	13.50	2025
	Concrete Slabs	175 c.y.	95.00	16625
	Concrete Walls	360 c.y.	130.00	46800
	Forms, Straight	9,000 sq.ft.	3.00	27000
	Riprap	200 c.y.	16.50	3300
	<u>Subtotal Stilling Basin</u>			<u>110200</u>
	<u>Discharge Channel</u>			
	Excavation, Alluvium	7,500 c.y.	3.00	22500
	<u>Additional Cofferdam</u>			
	Steel Sheet Piling	50 tons	600.00	30000
	Cell Fill	500 c.y.	13.50	6750
	Rock Protection, Flow Side	100 c.y.	20.50	2050
	<u>Subtotal Additional Cofferdam</u>			<u>38800</u>
	<u>Subtotal Discharge Manifolds with Stilling Basin</u>			<u>1226105</u>

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

Project Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 43 of 65 Pages
 Discharge Manifolds with Bent Discharge
 Structure Structure East of River Wall Estimated by JAT/VT Checked by VT

Item No.	ITEM	Quantity	Unit Price	Amount
	<u>PLAN No. 4B</u>			\$ U.S.
	Removal of Slab and Apron; Pg. 5 of 20 of Estimate			72 400
	Lower Guide Wall; Pg. 5 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			249 250
	Laterals Downstream of Landward Lock; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			206 935
	Intermediate Wall Extension; Pg. 6 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			310 900
	Laterals Downstream of Riverward Lock; Pg. 7 of 20 of Estimate (Unit price of concrete revised from Plan No. 1 to Plan No. 4)			215 120
	Subtotal			1 054 605
	<u>Discharge Structure East of River Wall</u>			
	Excavation, Alluvium	1,500 c.y.	3.00	4 500
	Remove Concrete Slab	130 c.y.	65.00	8 450
	Gravel Filter	150 c.y.	13.50	2 025
	Concrete Slabs	350 c.y.	95.00	33 250
	Concrete Walls	800 c.y.	130.00	104 000
	Forms, Straight	11,000 sq. ft.	3.00	33 000
	Forms, Curved	200 sq. ft.	6.00	1 200
	Riprap	250 c.y.	16.50	4 125
	Subtotal Discharge Structure			190 550
	<u>Discharge Channel</u>			
	Excavation, Alluvium	6,200 c.y.	3.00	18 600
	<u>Additional Cofferdam</u>			
	Steel Sheet Piling	50 tons	600.00	30 000
	Cell Fill	500 c.y.	13.50	6 750
	Rock Protection, Flow Side	100 c.y.	20.50	2 050
	Subtotal Additional Cofferdam			38 800
	<u>Total Discharge Manifolds with Bent Discharge Structure East of River Wall</u>			1 302 555

ESTIMATE

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOISProject Rehabilitation of Lock and Dam No. 1 Date Nov. 1975 Page 44 of 65 PagesStructure Reconstruction of Extension of River Wall Estimated by JAT/VT Checked by VT

Item No.	ITEM	Quantity	Unit Price	Amount
	<u>PLANS NOS. 4A & 4B</u>			\$ U.S.
	Remove Rockfill Dike	1,800 c.y.	4.50	8100
	Remove Mass Concrete	400 c.y.	65.00	26000
	Remove Timber Cribs	850 c.y.	9.00	7650
	Place New Timber Piles	2,000 lin.ft.	6.00	12000
	Trim Timber Piles	94 ea.	3.00	282
	Reconstruct Timber Cribs $850 + 350 = 1,200$ c.y.	1,200 c.y.	15.00	18000
	Concrete	400 c.y.	95.00	38000
	Forms, Straight	3,000 sq.ft.	3.00	9000
	Reconstruct Rockfill Dike $1,800 + 1,200 = 3,000$ c.y.	3,000 c.y.	5.00	15000
	Subtotal			134032
			USE	135000

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

ESTIMATE

Project REHABILITATION LOCK AND DAM #1 Date MARCH 1975 Page

Structure REPAIR OF CONCRETE SURFACES Estimated by RPH

Item No.	ITEM	PLAN NO 1			PLAN Quantity
		Quantity	Unit Price	Amount	
	REPAIR OF CONCRETE SURFACES				
	WITHOUT WALL ARMOR				
1.	CONCRETE REMOVAL	1650 CY	65.00	107 250	
2.	SHOTCRETE	1150 CY	175.00	201 250	
3.	CONCRETE (W/OT REINF. STEEL)	500 CY	80.00	40 000	
4.	PRECAST PANELS	220 CY	202.00	44 440	
5.	FORMWORK	9000 SF	3.00	27 000	
6.	BEDDING (PER GRAVEL)	150 CY 220 Tons	11.50	1 725	
7.	REPAIR CRACKS	250 LF	4.00	1 000	
8.	EPXY GROUT	50 GAL	25.00	1 250	
9.	ROCK BOLTS FOR MESH	3120 LF	6.00	18 720	
10.	REINFORCEMENT (REPAIR AND MESH)	75000 LBS	0.40	30 000	
11.	UPPER PROTECTION ANGLE	126,000 LBS	1.00	126 000	
12.	WALL ARMOR				
13.	ANCHOR BARS 4'	3100 LBS	1.75	5425	
14.	ANCHORS 3/4" Ø X 1'	3500 LBS	2.00	7000	
15.	JOINT SEALER	11,000 LF	3.00	33 000	
	Total			443 470	
		Use		443 000	

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Estimated by CPH Checked by _____

[illegible]

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SUBJECT Feasibility of Lock
Winter Rehabilitation
COMPUTED SMH CHECKED _____

PROJECT Lock & Dam No. 1
FILE NO 225 A
DATE 5/24/75 PAGE 46 OF 65 PAGES

The lock rehabilitation, for any of the four plans considered, involves work in five primary locations:

1. Lock interior - floor and walls
2. Culvert interiors
3. Ends of locks - miter gates, valves
4. Upstream of lock - intake manifold
5. Downstream of lock - discharge manifold

The last three of these areas involve work which can, using the assumed crew sizes shown in the computations, be easily accomplished during the 5 month winter construction period required by plans 1 and 4. The first two locations appear to require close supervision and planning in order to meet the desired schedule. In considering the feasibility of this winter work, the following sequences of events were arrived at as a means of completing the required work in the allotted time.

1. Lock Interior

clean surfaces

inspect concrete and repair lock floor

bore and fill grout holes

drill orifice holes

removal wall vertical face concrete

remove concrete for new orifices; clean up loose

install req'd wall reinforcement & shotcrete

reinforce, form, & pour new conduit orifices & plug old orifices

strip forms & clean up

This sequence of events would be accomplished with crew sizes chosen so that each major activity, would proceed at the same rate. In this way, a

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SUBJECT Feasibility of
Lock Winter Rehabilitation
COMPUTED SMA CHECKED _____

PROJECT Lock & Dam No. 1
FILE NO. 300 A
DATE 2/24/75 PAGE 47 OF 65 PAGES

steady flow of work could be maintained, with each task following the one preceding it around the lock. A consequence of this sort of scheduling is that the demand for manpower would be less variable. The manpower curve computed on the basis of the rough CPM diagram represents a pessimistic picture of actual fluctuations to be expected, since it does not consider the refined flow of activities described above. However, since some levelling of peaks in the manpower curve has already occurred in the computations (through the use of 'avg. weekly crew sizes', which consider a one-day crew of 6 equivalent to a one-week crew of 1), the manpower curve will be presented unmodified.

2. Culvert Interiors

- drill & fill grout holes; drill orifice holes
- cut break lines in culvert ceiling
- remove culvert ceiling concrete
- drill enlarged vent openings
- install & grout vent pipes
- install ceiling reinforcement
- slip form & pour ceiling concrete
- Clean up

While this work occurs, the culvert lowering and valve installation activities at the upstream culvert end proceed. It should be noted that some or all of the discharge conduits leading from the main culverts to the lock interiors might also be made working from the interior of the culverts, rather than from the lock interior itself. The suggested activity sequence should allow

HARZA
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CHICAGO

SUBJECT Feasibility of Lock
Winter Rehabilitation
COMPUTED SMA CHECKED _____

PROJECT _____
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DATE 22 Feb 70 Page 48 of 65 Pages

*for plan no. 1

a smooth flow of work in the culvert interior, avoiding the congestion the confined working area implies. Note that grouting occurs only in the intermediate wall culverts. This means that the lowering of the culvert ceiling in the land wall could proceed while grouting is in progress in the intermediate wall culvert or culverts.

Finally, consideration of the extent of rehabilitation must be made. Only the plans (1 and 4) involving major winter work are considered here, since the other plans are not subject to the rigid time constraints. If plans 1 and/or 4 can be accomplished, then certainly plans 2 and 3 are feasible.

The event sequencing described above, in view of the computed manpower curve for the project, implies the feasibility of plan 1, in which the landward lock only is rehabilitated, during the winter. The question of whether both locks could be repaired at this time remains.

If plan 4 is implemented, no increased congestion is foreseen in the lock interior work areas, since the riverward lock activities would be physically separate from those of the landward lock. The approximate doubling in overall manpower and equipment usage levels could, however, cause congestion in the staging areas.

Notes: 1. Activity durations are based on the assumption of two 10-hour shifts per day, six days per week.

2. No adjustment was applied to outdoor work to reflect the slower pace of construction in cold weather. Since this work is not critical

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Feasibility of Lock Winter Rehabilitation</u> COMPUTED <u>SMA</u> CHECKED _____	PROJECT <u>Lock & Dam No.</u> FILE NO. <u>200 A</u> DATE <u>2/25/75</u> PAGE <u>49</u> OF <u>65</u>
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Notes (cont.):

to the overall project completion deadline, this approach should not affect the feasibility of the project.

3. In order to accomplish small activities not broken down on the CPM (such as installation of compressed air lines for the dewatering system), the manpower curve projected for this project should be inflated by 10%. This addition will also subsume the extra man hours needed to accomplish the outdoor work under winter conditions.

Comments

Plan No. 1 - As indicated by the manpower curve, the peak manpower demand should be about 125 men, working upstream from the locks, downstream, and in the lock interiors. It is felt that this number will not overtax the capacity of the staging and project access areas; this plan is therefore considered feasible. Since no mechanical rehabilitation of the riverward lock is included under this plan, any delay in completing the winter construction will delay use of the lock the following spring. Scheduling is tight, but work should proceed smoothly if scheduled as suggested above.

Plan No. 2 - Peak manpower demand should be less than that for Plan No. 1, due to the longer period of lock rehabilitation and the higher worker productivity to be expected in the summer. This plan appears to present the least possibility of impediment to river traffic. Two possible problems require consideration. First, since

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Plan comparison</u> COMPLETED <u>SMA</u> CHECKED _____	PROJECT <u>K&D Dam No. 1</u> FILE NO. <u>800 A</u> DATE <u>3/22/76</u> PAGE <u>50</u> OF <u>65</u> PAGES
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Plan No. 2 (cont) - summer lock interior work proceeds without a cofferdam, the ability of the new lock bulkheads to keep the landward lock dry for long periods of time must be assured. Secondly, leakage of water from the adjacent riverward lock into the landward lock must be minimized. This could present a problem since grouting under the intermediate wall is not scheduled to begin until the summer.

Plan No. 3. The extended duration allowed the contractor for lock interior and exterior work under this plan makes it the easiest one for him to complete according to schedule. Manpower peak requirements should be even less than those for plan no 2. Unlike plan no. 2, no mechanical improvements are scheduled for the riverward lock, making it more difficult to use that lock should future repairs to the landward lock be required. The year long closure to river traffic is, of course, the primary disadvantage.

Plan No. 4 - With some exceptions, this plan represents a stereo duplication of plan no. 1. Little or no extra congestion is expected in the lock areas, since the workers in the two locks will be physically separate. Peak manpower requirements should be less than double those of plan no 1, since not all work is duplicated (i.e. both plans require grouting through both intermediate wall culverts) and since such a situation would encourage development of specialized crews to do one major task (such as culvert work) throughout the project, thereby

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Plan Comparison</u> COMPUTED <u>SMA</u> CHECKED _____	PROJECT <u>Lock & Dam No. 1</u> FILE NO <u>200 A</u> DATE <u>3/3/75</u> PAGE <u>51</u> OF <u>65</u> PAGES
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Plan No. 4 (cont.) - increasing overall worker productivity.

All Plans - There were two alternatives suggested concerning protection of the guidewalls from snubbing impact. The more expensive of the two involves removal of 1.3 feet of wall face concrete, installation of reinforcement and embedment of wall armor, and the forming and pouring of concrete. The second involves the removal of 4 inches of wall surface concrete, to be replaced by reinforced shotcrete. Both schemes include installation of steel angle protection for the edges of the walls.

The calculations upon which the manpower and concrete curves are based assume use of the second of these two schemes. Employment of the first scheme requires approximately half again as much concrete. Both schemes involve the use of precast panels, which are not explicitly considered in this analysis.

A large amount of reinforcing steel (.2 tons for each c.y. of poured concrete) was assumed in computing crew sizes, in order to include the manpower requirements for activities not always explicitly considered, such as stripping forms and installing precast panels.

HARZA
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CHICAGO

SUBJECT Guidewall Protection
Manpower Requirements
COMPUTED SMA CHECKED _____

PROJECT Lock Dam No. 1
FILE NO E20 A
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For protection scheme w/o wall armor, a total of about 1320 c.y. of shotcrete are to be applied to vertical wall faces of the upper guidewall, lock interior, and lower guidewall (plans 1, 2, 3). Since each of these structures is about 400 feet long, I will divide this total shotcrete evenly among the three structures:

concrete removed	shotcrete applied	structure
660 c.y.	460 c.y.	upper guide walls
660 "	460 "	lower " "
660 "	460 "	lock interior walls

Double the usually assumed reinforcement quantity will be included, in order to cover the extra time required to install anchor bolts and upper protection steel angle.

reinforcement	structure
184 tons	u.g.w.
184 "	l.g.w.
184 "	lock interior

Manpower requirements are determined using the Means Cost Data book, as for other activities included in this report.

[illegible]

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Bar Chart-Lock</u>	PROJECT <u>Lock & Dam No. 1</u>
	<u>Downstream Work Manpower</u>	FILE NO <u>B00 A</u>
	COMPUTED <u>SMA</u> CHECKED _____	DATE <u>3/27/75</u> PAGE <u>57</u> OF <u>65</u> PAGES

Activity	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Manifolds																				
a) sht piling	<u>3</u>																			
b) rem. l.g.w. monos.		<u>7</u>	<u>9</u>																	
c) rem. timber cribs			<u>2</u>																	
d) excavation (monos)				<u>2</u>																
g) clear apron				<u>1</u>																
h) remove "				<u>9</u>	<u>9</u>															
i) excavate (sandst)					<u>2</u>															
j) form manifolds								<u>6</u>	<u>6</u>											
reinf. "								<u>8</u>	<u>8</u>											
pour "									<u>4</u>											
k) form l.g.w. monos.										<u>10</u>	<u>12</u>									
reinf. " "										<u>12</u>	<u>12</u>									
pour " "												<u>12</u>								
l) inst. drain pipe							<u>4</u>													
m) backfill " "								<u>12</u>												
n) cutoff std. manif.									<u>4</u>											
o) rock protection															<u>2</u>					
p) exc. sandst. (int. w.)									<u>2</u>											
q) form int. w. extension															<u>10</u>	<u>10</u>	<u>12</u>			
reinf. " "															<u>15</u>	<u>15</u>	<u>15</u>			
pour " "																		<u>8</u>	<u>8</u>	
r) backfill l.g.w. mono.																<u>2</u>				
s) clean up																			<u>5</u>	<u>5</u>
Guidewalls																				
a) rem. vert. face conc.																				
b) reinf. " " "																				
c) apply " " "																				
TOTALS																				

3 13 13 28 8 28 12 37 16 10
11 14 6 20 28 26 35 35 18 0

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Manpower Levels</u>	PROJECT <u>Lock + Dam N</u>
	<u>for Upstream Work</u>	FILE NO. <u>800-A</u>
	COMPUTED <u>SMA</u> CHECKED _____	DATE <u>3/20/55</u> PAGE <u>01</u>

Plan No. 1		a		b		c	
Work Type		amt	unit	crew	type size (8 hrs.)	daily pro-	duction
1. Landward Intake Man.							
a) u.g.w. monoliths 1+2 sht. piling	21	tuns	9 men	9	30		
b) remove " " of u.g.w.	550	cy.	B-5	8	40		
c) lower u.g.w. foundation 3 ft.	1000	cy.	1 FEL	2	560		
d) remove culvert concrete	110	cy.	B-5	8	10		
e) plug land wall intakes	60	cy.	C-14	30	38		
f) form. land. intake manifold	6450	s.f.	C-1	4	215		
reinf. " " "	160	tons	4 rods	4	2.3		
pour " " "	800	cy.	C-7	8	80		
2. Intermediate Intake Man.							
a) remove top of mon. #1 conc.	1,150	cy.	B-5	8	40		
b) plug interm. wall intakes	60	cy.	C-14	30	38		
c) remove culvert concrete	90	cy.	B-5	8	10		
d) form. interm. wall intake man.	2500	s.f.	C-1	4	215		
reinf. " " " "	116	tons	4 rods	4	2.3		
pour " " " "	580	cy.	C-7	8	80		
e) form. top of monolith #1	3,950	s.f.	C-2	5	260		
reinf. " " " "	92	tons	4 rods	4	3.0		
pour " " " "	460	cy.	C-7	8	95		
3. Upstream Apron							
a) excavate (sand)	3000	cy.	1 FEL	2	560		
b) apply gravel bedding (6")	350	cy.	1 FEL	2	500		
c) form concrete slab (2")	slab			6	-		
reinf. " " "	140	tons	4 rods	4	2.3		
pour " " "	1,400	cy.	C-7	8	100		
4. Guidewalls							
a) remove vertical face conc.	660	cy.		1	8		
b) reinforce " " "	184	tons rods		4	1.6		
c) apply " " "	460	cy.		5	20		

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Lock & Dam No. 1
800-A
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HARZA
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SUBJECT

COMPUTED

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FILE NO.

DATE

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⑥ ... daily pro- duction size (8 hrs.)	duration (weeks) ⑦ ⑧ x 2.5 x 6	Allowed Activity Duration (weeks)	Req'd avg. Weekly crew size	Week no.s	Concrete Pours c.y./week
9 30	1/6	4	say 2	1-5	
8 40	1	3	3	5-8	
2 560	1/6	1	say 2	8	
8 10	1	1	8	8	
30 38	1/6	1	5	9	
4 215	2	2	4	9-11	
4 2.3	5	5	4	11-16	
8 80	1	3	3	16	800
8 40	2	3	8	5-8	
30 38	1/6	1	5	10	
8 10	1/2	1	4	8	
4 215	1	2	4	9-11	
4 2.3	4	2	8	9-11	
8 80	1/2	3	4	11	580
5 260	1	2	5	13	
4 3.0	3	2	6	13-15	
8 85	1/2	3	3	15	460
2 560	1/2	1	say 2	1	
2 500	1/6	1	say 2	2	
6 -	1	1	6	3	
4 23	4	4	4	4-8	
8 100	2	2	8	8-10	700
1 8	27	15	2	2-17	
4 1.6	12	6	8	12-18	
5 20	2	2	5	18-20	230

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Manpower Levels for</u>	PROJECT <u>Lack & Don No.</u>
	<u>Downstream Works</u>	FILE NO. <u>B00 A</u>
	COMPUTED <u>SMA</u> CHECKED _____	DATE <u>3/20/75</u> PAGE <u>1</u> OF <u>1</u>

Work Quantities - Plan No. 1

Work Type	amount	unit	Crew type size	daily prod. (hr.)	duration (week)
Manifolds					
a) install sheet piling	5,400	sf.	B-30 3	500	
b) remove lg. w. monos. 1, 2, & 3	1,100	c.y.	B-5 9	40	
c) rem. timber cribs	?		2 2		
d) excavation for new monos.	280	c.y.	B-10FF 2	560	
f) back fill lg. w. monolith	250	c.y.	B-10FFEL 2	250	
g) clean apron & slab	500	c.y.	B-10FFEL 2	250	
h) remove " "	1,100	c.y.	B-5 9	30	
i) excavate (sandstone)	1,000	c.y.	B-10 2	100	
j) manifold forms	10,000	sf.	C-1 4	215	
" reinf.	180	tons	4 rod m 4	3.0	
" pouring	900	c.y.	C-7 8	150	
e) lg. w. man. mon. forms	7,500	sf.	C-2 5	235	
" " reinf.	260	tons	4 rod. 4	2.3	
" " pouring	1,300	c.y.	C-7 8	80	
k) install drain pipe (12" & 24" Ø)	705	ft.	B-21 4	110	
l) backfill on drains (gravel)	200	c.y.	1 (lab) 1	12	
m) cutoff wall & downstr. manif.	1080	c.y.	B-11 2	90	
n) place rock protection	650	c.y.	B-10 2	1000	
o) excavate sandstone (int. wall)	300	c.y.	B-10 2	100	
p) interm. wall extension forms	13000	sf.	C-2 5	200	
q) " " " reinf.	350	tons	4 rod m 4	23	
r) " " " pouring	2,500	c.y.	C-7 8	95	
Guidewalls					
a) remove vert. face concrete	660	c.y.		8	
b) reinf. " " "	184	tons	rod m. 4	16	
c) apply " " "	460	c.y.		20	

notes: 1. For jobs which require less than 1 week, +
2. Jobs completed before the allotted time

PROJECT Lock & Dam No. 1
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* From Means Cost Data, 1975 ed.

crew size	daily production (8 hr.)	duration (weeks)	Allowed Activity Duration (weeks)	Req'd avg. weekly crew size	Week Nos.	Concrete Pours Cy./Week
3	500	1	1	3	1	
9	40	2	2	9	2-4	
2		1	$\frac{1}{6}$	2	3	
2	560	$\frac{1}{6}$	$\frac{1}{6}$	2	4	
2	250	neg.	-	say 2	15	
2	250	neg.	-	1	4	
9	30	2	2	9	4-6	
2	100	1	1	2	5	
4	215	3	2	6	7-9	
4	3.0	4	2	8	7-9	
8	150	$\frac{1}{2}$	1	4	9	450
5	235	2	1	10	10-12	
4	23	8	1	16	10-12	
8	80	2	1	16	12	1300
4	110	1	1	4	6	
1	12	2	$\frac{1}{6}$	12	7	
2	90	1	1	say 4	8	1000
2	1000	1	1	2	13	
2	100	1	1	2	9	
5	200	6	3	10	14-17	
4	23	10	3	15	14-17	
8	95	2	2	8	17-19	1250
1	8	27	15	2	2-17	
4	16	12	6	8	12-18	
5	20	2	2	5	18-20	230 -

than 1 week, the crew size is averaged over a whole week.
 allotted time nevertheless employ full crews for the allotted time.

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SUBJECT Manpower levels -
Interior Work
COMPUTED SMA CHECKED _____

PROJECT Lock & Dam No.
FILE NO 800 A
DATE 3/21/75 PAGE _____ OF _____

1. Base + vertical face of wall - Plan No. 1

work type	amount	unit	type
a) clean surfaces	lock		
b) inspect + repair floor + floor slabs	lock		
c) break out cond. opngs. - land w.	110	c.y.	
" " " " - int w.	100	c.y.	
d) Remove wall face concrete	660	c.y.	
e) clear " " " " "	660	c.y.	
f) " " " " reforcem. " "	184	tons	
g) " " " " shotcrete " "	460	c.y.	
h) Clean up shotcrete	lock		
i) orifice reforcem. - land w.	26	tons	
" " " " - int. w.	30	tons	
j) " formwork - land w.	2200	s.f.	
" " " " - int. w.	1500	s.f.	
k) " concrete - land w.	130	c.y.	C-7
" " " " - int. w.	150	c.y.	C-7
l) strip orifice fmwk - land w.	2200	s.f.	
" " " " - int. w.	1500	s.f.	
m) drill grout holes - int. w.	132	holes	
n) pump grout - int. w.	132	holes	
p) drill 2" orifice holes - B/orifice - land wall	80	holes	
p) " " " " " " - int. wall	80	holes	

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Lock & Dam No. <u>1</u>	HARZA ENGINEERING COMPANY CHICAGO	SUBJECT _____	PROJECT _____
<u>800 A</u>		FILE NO _____	DATE _____
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unit	type	crew size	Daily Prod. (20 hr.)	Duration (weeks)	Allowed act. duration	Reg'd avg. week-ly crew size	Week Nos.	Concrete c.y./week
		3	—	$\frac{1}{6}$	$\frac{1}{6}$	1	1	
		2	—	7	5	3	2-9	
c.y.		4	14	2	2	4	2-4	
c.y.		4	14	2	5	2	2-7	
c.y.		1	4	27	15	2	2-17	
c.y.		1	20	6	15	1	2-17	
tons		4	25	12	6	8	11-17	
c.y.		5	50	2	2	5	17-19	230
		3	—	$\frac{1}{6}$	$\frac{1}{6}$	1	20	
tons		4	25	2	4	2	7-11	
tons		4	25	2	4	2	7-11	
s.f.		4	750	$\frac{1}{2}$	4	1	14-18	
s.f.		4	750	$\frac{1}{2}$	4	1	14-18	
c.y.	C-7	8	100	5	1	3	18	130
c.y.	C-7	8	100	5	1	3	18	150
s.f.		4	3000	$\frac{1}{6}$	1	1	20	
s.f.		4	3000	$\frac{1}{6}$	1	1	20	
holes		3	3	$1\frac{1}{3}$	8	3	2-10	
holes		3	6	$3\frac{1}{3}$	8	3	6-10	
holes		3	4	$3\frac{1}{3}$	2	8	2-4	
holes		3	4	$3\frac{1}{3}$	4	4	2-6	

HARZA ENGINEERING COMPANY CHICAGO	SUBJECT <u>Man power levels -</u>	PROJECT <u>Lack Dam No. 1</u>
	<u>Interior Work</u>	FILE NO <u>B00 A</u>
	COMPUTED <u>SMA</u> CHECKED _____	DATE <u>3/21/75</u> PAGE _____ OF _____

Work Quantities - Plan No. 1

2. Top of walls, ends of lock

Work Type	Amount	Unit	Type	Crew Size
a) remove stoney gate	4	—		4
b) remove miter gate operator	4	—		4
c) remove valve bulkhead concr.	160	c.y.		4
d) remove loose concrete	160	c.y.		5
e) install mt. gt. op. embedded pts	4	—		4
f) " " " " reinforcement	5	ton	rod m.	4
g) " " " " formwork	100	s.f.	C-2	5
h) pour " " " concrete	10	c.y.	C-7	8
i) install valve blk. embedded pts.	6	—		3
j) " " " " reinforcement	7	tons	rod m.	4
k) " " " " formwork	200	s.f.	C-2	5
l) pour " " " concrete	80	c.y.	C-7	8
m) strip forms	300	s.f.		1
n) install new mt. gt. operator	4	—		4
o) drill shear keys (vert. & horiz.)	8	holes		6
p) pour shear keys (" ")	52	c.y.	C-7	8
q) misc. (mooring bits, etc.)	—			30
r) upper miter gate repairs	1	lock		9
s) lower " " " "	1	lock		14
t) upper miter gate sandbl. & pntng.	1	lock		4
u) lower " " " "	1	lock		4
v) remove lock blkhd concrete	140	c.y.		4
w) install " " embedded parts	4	—		4
x) " " " reinforcement	4	tons	rod m.	4
y) " " " formwork	500	s.f.	C-2	5
z) pour " " " concrete	70	c.y.		8
aa) reinforce slab on tops of walls	180	tons	rod m.	4
ab) form " " " "	20000	s.f.	C-2	5
ac) pour " " " "	900	c.y.	C-6	6

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PROJECT - JACKSON Dam No. 1

HARZA
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COMPANY
CHICAGO

SUBJECT

PROJECT

FILE NO 300 A

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Type	Crew Size	Daily (20 hr.) Production	Duration (weeks)	Allowed Activity Duration	Req'd avg. Weekly Crew Size	Week Nos.	Concrete c.y./week
	4	—	2	2	4	2-4	
	4	—	1 1/3	5	4	5	
	4	15	2	6	2	4-10	
	5	100	3	3	2	10	
	4	—	1	2	4	8	
rodm.	4	42	1/6	1	1	9	
C-2	5	250	1/6	1	1	10	
C-7	8	40	1/6	1	2	11	10
	3	—	7	2	12	10-12	
rodm.	4	42	1/3	1	1	13	
C-2	5	250	1/6	1	1	14	
C-7	8	40	1/3	1	3	15	80
	1	600	1/6	1	1	16	
	4	—	2	3	4	14-17	
	6	23	2	2	6	4-6	
C-7	8	40	1/3	3	8	6	52
	30	—	1	15	2	2-17	
	9	—	3	3	9	3-6	
	14	—	3	3	14	6-9	
	4	—	4	4	4	6-10	
	4	—	4	4	4	10-14	
	4	15	2	2	4	9-11	
	4	—	1	1	4	11	
rodm.	4	42	1	1	4	12	
C-2	5	250	1/2	1/2	3	13	
	8	40	1/3	1/3	3	13	70
rodm.	4	75	1	4	4	2-6	
C-2	5	250	6	6	5	10-16	
C-6	6	287	4	4	6	16-20	225

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SUBJECT Lock Interior
Work Scheduling, Plan 1
COMPUTED SMA CHECKED _____

PROJECT Lock & Dam N
FILE NO 800 A
DATE 3/21/75 PAGE 1 OF 1

Work Quantities - Plan No. 1

3. Culverts - interior of lock walls

Work Type	Amount	Unit	Type	Crew
				Size
a) drill grout holes (int. wall only)	198	holes		3
b) inject grouting (" " ")	198	holes		3
c) enlarge vents in culverts	400	ft.		2
d) cut culvert ceiling break-line	1600	ft.	A-1	2
e) remove " " concrete	100	c.y.		2
f) install " " vent pipes	400	ft.		3
g) grout " " " "	10	c.y.		3
h) pour " " concrete	600	c.y.	C-7	8
i) remove conc. to lower culverts	1200	c.y.	B-9	8
j) form new lower culverts	2000	sf.	C-1	4
k) reinforce " " "	160	tons	4 rod m	4
l) pour conc. for " "	800	c.y.	C-7	8
m) reinf. upper culverts & gate slots	80	tons	4 rod m	4
n) fill " " " "	1000	c.y.	C-7	8
o) install new slide valves	2	valve		3
p) drill 2" orifice holes - 8/orifice	80	holes		3

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PROJECT Lock & Dam No. 1	HARZA	SUBJECT	PROJECT
NO 300 A	ENGINEERING		FILE NO
3/21/75 PAGE 1 OF 1	COMPANY CHICAGO	COMPUTED	CHECKED
			DATE 63 65

Crew		Daily (8-hr.)	Duration	Allowed	Req'd	Avg.	Week	Concrete
Type	Size	Production	(Weeks)	Activity	Weekly	Size	Nos.	C.y./week
	3	1.2	11	8	6		2-10	
	3	2.4	5 1/2	8	3		3-11	
	2	10	4	2	4		2-4	
A-1	2	182	4	1	8		4	
	2	6	2	2	2		5-7	
	3	80	3	3	1		7	
	3	5	4	1	1		7	
C-7	8	50	1	5	use 4		8-15	120
B-9	8	70	1 1/2	3	4		4-7	
C-1	4	170	1	3	2		8-11	
4 rod m	4	1.8	6	3	8		7-10	
C-7	8	160	1	4	2		11-15	200
4 rod m	4	1.8	3	3	4		7-10	
C-7	8	120	1 1/2	4	use 2		11-15	250
	3	4	1/2	2	2		15	
	3	1.6	3 1/3	4	3		2-6	

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HARZA
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SUBJECT Manpower + concrete
Weekly Volumes - Summary
COMPUTED SMA CHECKED _____

PROJECT Lock + Dam N
FILE NO 800 A
DATE 3/20/75
(CHS-7) 3/22/75

Week no.	Upstream		Downstream	
	labor (men)	concrete (c.y.)	labor (men)	concrete (c.y.)
1	4	0	3	0
Nov. 2	6	0	11	0
3	10	0	13	0
4	8	0	14	0
5	17	0	13	0
Dec. 6	17	0	6	0
7	17	0	28	1300
8	29	700	20	1080
9	43	700	8	0
Jan. 10	25	0	28	0
11	10	580	28	0
12	14	0	26	450
13	25	0	12	450
Feb. 14	20	0	35	0
15	17	460	37	0
16	13	800	35	0
17	13	0	16	1250
March 18	10	230	18	1480
19	5	230	10	230
20	0	0	0	0

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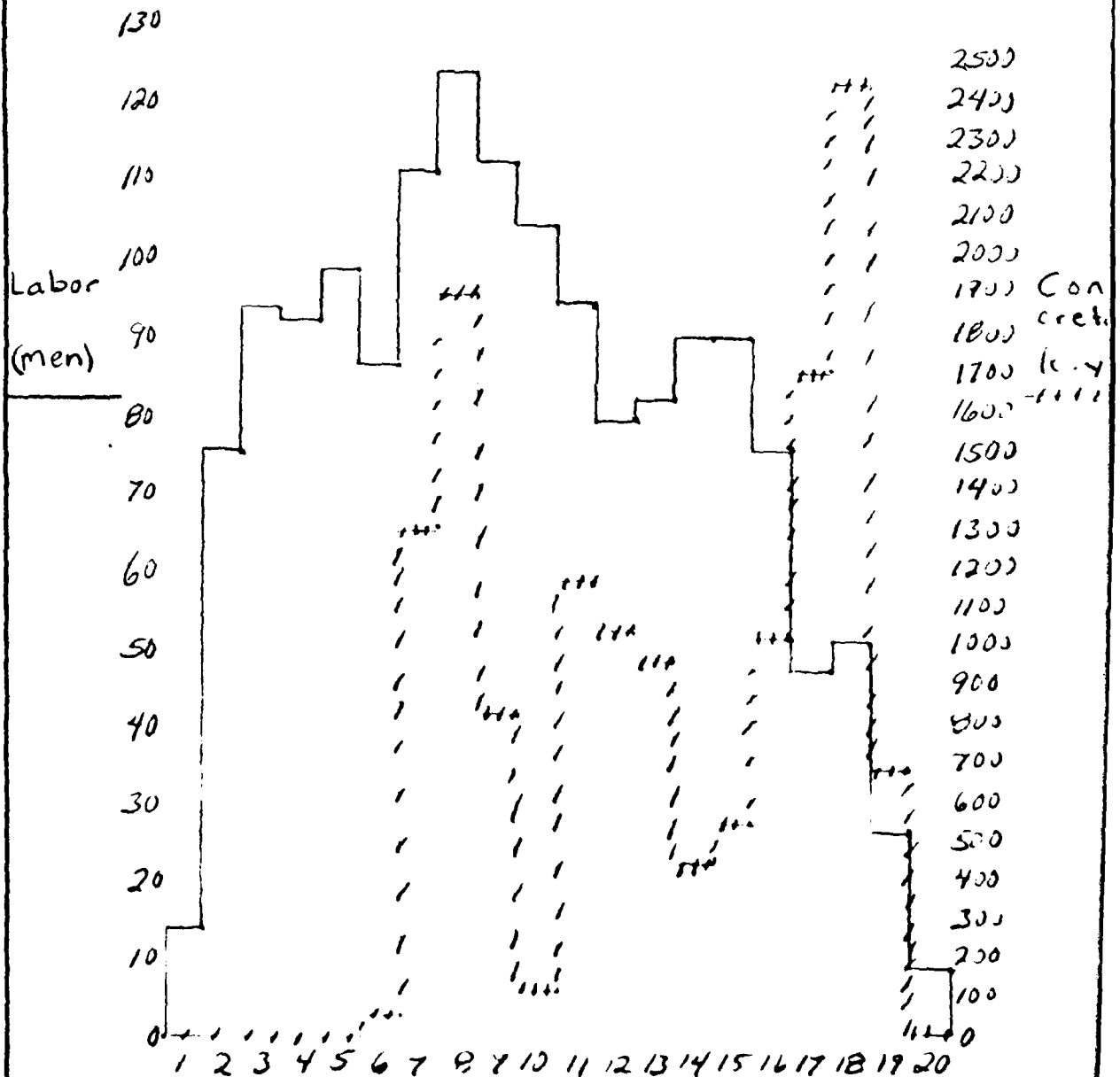
PROJECT <u>Lock & Dam No. 1</u> AS NO <u>300 A</u> DATE <u>3/20/75</u>	HARZA ENGINEERING COMPANY CHICAGO	SUBJECT _____ _____ COMPUTED _____ CHECKED _____	PROJECT _____ FILE NO _____ DATE _____ Page <u>64</u> of <u>65</u> PAGES
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		Subtotal					
Downstream		Exterior		Lock Interior		Total	
Concrete	labor	Concrete	labor	Concrete	labor	Concrete	labor
(c.y.)	(men)	(c.y.)	(men)	(c.y.)	(men)	(c.y.)	(men)
0	7	0		6	0	0	13
0	17	0		58	0	0	75
0	23	0		70	0	0	93
0	22	0		70	0	0	92
0	30	0		68	0	0	98
0	23	0		64	52	52	81
1300	45	1300		66	0	1300	111
1080	49	1780		74	120	1900	123
0	51	700		61	120	820	112
0	53	0		51	120	120	104
0	38	580		53	580	1160	94
450	40	450		39	570	1020	79
450	37	450		45	520	970	82
0	55	0		34	450	450	89
0	54	460		34	80	540	89
0	48	800		27	225	1025	75
1250	29	1250		18	455	1705	47
1480	28	1710		22	715	2425	50
230	15	460		11	225	685	26
0	0	0		8	0	0	8

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SUBJECT Manpower + Concrete
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